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SUPPLEMENT ANALYSIS: PIT MANUFACTURING FACILITIES AT LOS ALAMOS NATIONAL LABORATORY, STOCKPILE STEWARDSHIP AND MANAGEMENT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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SUMMARY

The 1996 Department of Energy (DOE) Stockpile Stewardship and Management (SSM) Programmatic Environmental Impact Statement (PEIS) analyzed the environmental impacts of locating an enhanced pit manufacturing[1] *capability at either its Los Alamos National Laboratory (LANL) or its Savannah River Site (SRS). In December 1996, DOE issued a Record of Decision (ROD) reestablishing the pit manufacturing mission at LANL. In August 1998, the U.S. District Court for the District of Columbia, while ruling in DOE's favor in litigation challenging the adequacy of the SSM PEIS, directed DOE to take another look at certain new studies regarding seismic hazards at LANL, and to provide a factual report and technical analysis of the plausibility of a building-wide fire at LANL's plutonium facility (PF-4 at TA-55). The Court directed that DOE prepare a Supplement Analysis to help determine whether a supplemental SSM PEIS should be issued to address these studies.*

DOE has analyzed the seismic and fire issues in this Supplement Analysis and has concluded that there is no need to prepare a supplemental SSM PEIS to address reestablishing pit manufacturing capability. The seismic studies, although they contain new information, do not provide significant information beyond that considered in the SSM PEIS. The analyses of the plausibility and consequences of building-wide fires indicates that such fires are extremely unlikely to occur and that the consequences would not be greater than those identified through other analyses, including the SSM PEIS. The risk of building-wide fires at TA-55 does not change as a result of adding the pit manufacturing mission to TA-55. Moreover, these risks are very low and represent only a small fraction of the DOE Safety Goal. Through this Supplement Analysis DOE concludes that neither a Supplemental PEIS nor a new EIS is necessary.

INTRODUCTION

Purpose of this Document

This document is a Supplement Analysis prepared pursuant to 10 CFR 1021.314(c) to assist the Department of Energy (DOE) in determining whether to supplement its *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE/EIS-0236), September 1996 [A.R. No. I-1561][2] (SSM PEIS) by preparing a Supplemental SSM PEIS. This Supplement Analysis specifically addresses the issue of those aspects of DOE's nuclear weapons pit manufacturing capability and capacity that were assigned to Los Alamos National Laboratory (LANL) in the SSM Record of Decision (ROD) (a "pit" is a central component of a nuclear weapon). Site-specific implementation of the SSM pit decision was analyzed in the *Site-Wide*

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[1] For the purposes of this Supplement Analysis, the terms manufacturing and fabrication are synonymous, and defined in the Los Alamos National Laboratory (LANL) SWEIS, Page 2-29. Production is also defined in the LANL SWEIS as fabrication/manufacturing of a relatively large quantity of parts.
[2] All references to "A.R" are to the Administrative Record compiled for the preparation of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement.

Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (SWEIS, DOE/EIS-0238, January 1999).

Background - SSM PEIS

Before considering whether the SSM PEIS should be supplemented, this Supplement Analysis addresses background information regarding the PEIS, its purpose, the formulation of issues in the PEIS, and the decisions reached based on the PEIS. This information assists in arriving at conclusions regarding supplementing the SSM PEIS or preparing a new EIS to address pit manufacturing.

The SSM PEIS was prepared in accordance with the National Environmental Policy Act (NEPA) [42 USC 4321 et seq.], the Council on Environmental Quality (CEQ) NEPA implementing regulations [40 CFR Parts 1500 - 1508], and the DOE NEPA implementing regulations [10 CFR Part 1021]. In March 1996 DOE published a Draft PEIS on its nuclear weapons SSM Program [A.R. No. I-1385]; DOE published the Final SSM PEIS in September 1996 [DOE/EIS-0236, A.R. No. I-1561]. The SSM PEIS analyzed at a programmatic level how DOE might carry out its nuclear weapons mission assignments, including alternative locations where DOE might assign various SSM missions. A ROD, based in part on the environmental analyses in the SSM PEIS, was issued on December 19, 1996 [61 FR 68014, A.R. No. I-1606, A.R. No. VII.B-26]. The SSM PEIS and ROD addressed the programmatic decisions facing DOE regarding implementation of its SSM program. A two-tiered NEPA strategy was adopted wherein implementing the programmatic decisions at a site-specific level in many cases would be accomplished through subsequent tiered project-specific NEPA reviews [SSM PEIS Vol. I, Sec. 1.5, p. 1-8; see also SSM ROD, Sec. 3.A.4].

The SSM PEIS and the SSM ROD covered those proposed actions which were the salient decision factors for determining how DOE would implement the SSM program for the foreseeable future. One of the proposals involved “Reestablishing Manufacturing Capability and Capacity for Pit Components” [SSM PEIS, Vol. I, Sec. 2.5.3, p. 2-11]. Capability is the practical ability to perform a basic function, and SSM capabilities are needed independent of future nuclear weapons stockpile sizes. Capacity is the size of the capability; for example, the number of components that could be fabricated at a specific facility over a specific time. The SSM PEIS analyzed the potential capacity at different sites to support a potential nuclear weapons stockpile of various sizes (numbers of weapons) in order to examine the sensitivity of programmatic decisions to transfer weapons manufacturing activities to sites such as LANL [SSM PEIS Vol. I, Sec. 1.1, p. 1-2].

DOE needed to reestablish the capability to produce stockpile-ready pits that was lost in 1992, when DOE ceased plutonium pit manufacturing operations at its Rocky Flats Plant (RFP) (now known as the Rocky Flats Environmental Technology Site) in Colorado [SSM PEIS Vol. I, Sec. 2.5.3, p. 2-11]. The programmatic question addressed in the SSM PEIS and ROD related to pit manufacturing was which DOE site should receive this mission assignment. Programmatic alternatives for locating pit manufacturing alternatives were limited to sites which had some level of technical or facility infrastructure [SSM PEIS Vol. I, Sec. 2.5.3, p. 2-11; SSM PEIS Vol. I, Sec. 3.4.3, p. 3-57]. SSM PEIS alternatives included reestablishing pit capability and capacity at the DOE’s LANL; reestablishing the capability and capacity at the DOE’s Savannah River Site (SRS); or to continue to rely on the existing capability and capacity at LANL and the DOE’s Lawrence Livermore National Laboratory (LLNL). LANL’s facility infrastructure is located in several buildings at different Technical Areas (TAs). The three siting alternatives discussed and analyzed in the SSM PEIS were:

- No Action (continue to use existing limited capabilities at LANL and continue to use the limited capability at LLNL to support material and technology development);
- Reestablish pit fabrication at LANL (use existing facilities at TA-55, -3, -8, -50 and -54, and construct some upgrades);
- Reestablish pit fabrication at SRS (use space in existing “hardened” nuclear facilities with extensive equipment and construction upgrades).

The SSM PEIS provided a comparative analysis of the programmatic impacts that would be expected to occur if the pit fabrication capability were to be reestablished at either LANL or SRS, compared against the No Action baseline [SSM PEIS, Vol. I, Section 4.6.3, p. 4-276]. Because construction of new buildings was not anticipated to be needed in order to assign the pit fabrication mission to LANL, notable environmental impacts were primarily limited to those from operations, such as radiological impacts and socioeconomic impacts. If the pit manufacturing mission had been relocated to SRS, some new construction would have been needed [SSM PEIS, Vol. I, Section 4.3.3, p. 4-107]. Appendix A [SSM PEIS, Vol. II, Sec. A.1.5, p. A-28] provided greater detail of the Defense Programs facilities in use at LANL, including the plutonium (Pu) facilities at TA-55 and the Chemical and Metallurgical Research (CMR) Building and Sigma Complex at TA-3, [Table A.1.5-1]. Similar information was presented for SRS [SSM PEIS, Vol. II, Sec. A.1.2, p. A-10]. Appendix A also discussed the specific facilities anticipated to be used for pit manufacturing at LANL [SSM PEIS, Vol. II, Sec. A.3.3.1, p. A-117]; a list of specific facilities (including the Plutonium Facilities (PF) 4 at TA-55 and CMR at TA-3 and type of construction was provided [SSM PEIS, Vol. II, Table A.3.3.1-1]. Appendix A pointed out that if LANL were selected as the pit manufacturing site, the then-current stockpile pit rebuild program at LANL would be absorbed within the pit manufacturing effort since the activity would be the same --only the number of pits would be different (greater) [SSM PEIS Vol. II, p. A-120]. Similar information was provided for SRS [SSM PEIS Vol. II, Sec. A.3.3.2, p. A-124]

The SSM PEIS established that:

- DOE needed to reestablish pit manufacturing capability
- LANL and SRS were the two reasonable alternative sites for pit manufacturing
- There would be no significant difference in the human health and environmental impacts of locating this program at either LANL or SRS
- Site-specific implementation of the pit manufacturing mission would be further analyzed in subsequent, tiered, site-specific NEPA reviews [SSM PEIS Vol. I, Sec. 1.5, p. 1-8]

In December 1996, DOE issued its programmatic decisions regarding how it would implement the SSM Program. The SSM ROD was based on more than just the environmental analysis of the SSM PEIS. DOE considered "other factors such as DOE statutory mission requirements, national security policy, cost, schedule, and technical risks. Additional technical descriptions and assessments of cost, schedule and technical risk are found in the Analysis of Stockpile Management Alternatives (DOE/AL, July 1996), the Stockpile Management Preferred Alternatives Report (DOE/AL, July 1996)" [SSM ROD, Supplementary Information -- Background]. The technical and cost analyses for production capability and capacity alternatives analyzed in the SSM PEIS were covered in the draft "Stockpile Management Preferred Alternatives Report" [A.R. No. I-1381] and the "Analysis of Stockpile Management Alternatives" [A.R. No. I-1381], both dated February 1996, mentioned in the Final SSM PEIS [see, for example, SSM PEIS Vol. IV, comment response 40.18, p. 3-107]. The analyses in these reports showed that, compared to SRS, locating the pit manufacturing mission at LANL would be lower in cost and have less technical risk because LANL had recent experience in providing pits for nuclear explosive testing [SSM PEIS Vol. IV, comment response 32.03, p. 3-81; 32.06, p. 3-81]. These draft reports mentioned in the SSM PEIS were released in final form in July 1996 [A.R. No. I-1506], following the SSM PEIS and were used by the decisionmaker in determining SSM Program implementation decisions.

The DOE SSM decision regarding reestablishing pit fabrication was:

> ...to reestablish the pit fabrication capability, at a small capacity, at LANL. ... This decision limits the plutonium fabrication facility plans to a facility sized to meet expected programmatic requirements over the next ten or more years. It is not sized to have sufficient capacity to remanufacture new plutonium pits at the same production rate as that of their original manufacture. DOE will perform development and demonstration work at its operating plutonium facilities over the next several years to study alternative facility concepts for larger capacity. Environmental analysis of this larger capacity has not been performed at this time because of the uncertainty in the need for such capacity and the uncertainty in the facility technology that would be utilized. Should a larger pit

fabrication capacity be required in the future, appropriate environmental and siting analysis would be performed at that time.

Mitigation. Specific mitigation measures are not addressed for the stockpile management decisions of the ROD, although many potential mitigation measures are identified in the PEIS. In accordance with the Stockpile Stewardship and Management Program's two-tiered NEPA Strategy, these specific mitigation measures will be addressed, as necessary, on a site-by-site basis, in any site-specific NEPA analyses needed to implement the stockpile management decisions of this ROD. [ROD, A.R. No. I-1606, Sec. 3.A.4]

Judicial Review of SSM PEIS

In May 1997, a coalition of 39 organizations including the Natural Resources Defense Council (NRDC) brought an action in the U.S. District Court for the District of Columbia against DOE for failure to comply with NEPA. The plaintiffs alleged that DOE, among other things, failed "to adequately analyze the environmental effects of, and reasonable alternatives to" the SSM Program [*NRDC v. Peña*, Complaint for Declaratory and Injunctive Relief, May 2, 1997, p. 7]. Plaintiffs sought to enjoin construction of new SSM facilities, as well as major upgrades to mission capability. On August 8, 1997, the Court denied plaintiffs' motion. In January 1998, plaintiffs filed an amended complaint against DOE for alleged failure, among other things, "to prepare a Supplemental [PEIS] based upon significant new information regarding the potential environmental impacts arising from ... the fabrication of nuclear weapon cores, or pits, at [LANL], [*NRDC v. Peña*, Amended Complaint for Declaratory and Injunctive Relief, January 30, 1998, p. 6 - 7]. DOE and plaintiffs subsequently cross-filed for summary judgment on the issue of whether or not a Supplemental PEIS would be required to address four issues: recent studies of seismic risks at LANL; likelihood of plutonium fires such as occurred in the past at RFP; plans for a larger pit production facility; and plans for future use of the National Ignition Facility at LLNL. The parties engaged in extensive, but ultimately unsuccessful, discussions regarding the possibility of settlement. The Court then directed each of the parties to file a draft summary judgment order. DOE's draft order provided that DOE would prepare a Supplement Analysis on implementing pit production at LANL. On August 18, 1998, the Court issued a Memorandum Opinion and Order ("August 18 Order," or "Order"), which denied plaintiffs' motion for summary judgment and granted DOE's motion.

In its August 18 Order, the Court directed DOE to take six actions with regard to plutonium pit fabrication.

1. Prepare, peer-review, and publish by December 31, 1998, the following seismic studies:

    Strategic [Stratigraphic] Survey for Technical Area (TA)-55,
    FY97 Pajarito Trench Study,

Core Holes (Facility Specific) Study
Probabilistic Surface Rupture Assessment for Technical Area (TA) -3

2. Prepare, peer-review, and publish by March 31, 1999, the following seismic studies:

   Strategic [Stratigraphic] Survey for TA-3
   FY98 Pajarito Trench Study

3. Upon completion of the above seismic studies, issue a Supplement Analysis to the SSM PEIS, to contain a technical analysis of whether the information presented in the seismic studies is “significant” within the meaning of NEPA.
4. This Supplement Analysis is also to contain a technical analysis and full factual report on the projected extent to which a building-wide fire at the LANL plutonium facility PF-4 at TA-55 would result in the release of ^{238}Pu and ^{239}Pu. The technical analysis is also to include a re-examination of the plausibility of a building-wide fire under the following three hypothetical circumstances: the propagation of a “glove-box” fire to a building-wide fire; a building-wide fire resulting from a severe earthquake; and a building-wide fire resulting from sabotage.
5. The Supplement Analysis is to be issued in draft form for a 30-day public comment period. After considering the information in the Supplement Analysis and the public comments received, DOE is to determine whether there is a need to prepare a Supplemental SSM PEIS. If DOE determines a Supplemental SSM PEIS is required, it is to be prepared in accordance with 10 CFR 1021.314.
6. A Supplemental SSM PEIS will be prepared prior to taking any action committing to a pit production capability for a capacity in excess of the level analyzed in the SSM PEIS (in other words, fabrication of pits at a rate greater than 50 pits per year under routine conditions and 80 pits per year under multiple shift operations).

ISSUES RELATED TO PIT MANUFACTURING FACILITIES

Overview

This Supplement Analysis has been prepared to help DOE determine whether to supplement that portion of the SSM PEIS which deals with the proposed action to reestablish at LANL a manufacturing capability and capacity for pits. It specifically examines five issues raised through judicial review.

These issues are:

- Implications of recent seismic studies regarding pit manufacturing actions at LANL

- Plausibility of a building-wide fire at LANL propagated from a glovebox
- Plausibility of a building-wide fire at LANL resulting from a severe earthquake
- Plausibility of a building-wide fire at LANL resulting from sabotage
- Extent to which a building-wide fire at LANL would result in the release of plutonium

The Supplement Analysis also examines the following issue not identified through judicial review;

- Extent to which a building-wide fire could result in consequences to the General Public, and implications for siting the pit fabrication mission.

This section describes in more detail these six issues examined in this Supplement Analysis. First, it describes and defines certain facilities and certain terms to allow a better understanding of the discussion of issues.

Explanation of Terms

"Pit Manufacturing": The SSM PEIS analyzed, at a programmatic level, the impacts of locating the pit manufacturing (also known as fabrication) mission at LANL. The PEIS presumed that pit manufacturing activities at LANL would take place in PF-4 at TA-55, which is the main plutonium processing facility at LANL. The PEIS noted that other activities and facilities would be used to support pit manufacturing, such as the analytical chemistry services provided at the CMR Building, at TA-3.

"Plutonium" is an element used in nuclear weapons that has various isotopic forms. "^{238}Pu" is an isotopic form used for Radioisotopic Thermoelectric Generators (RTGs), which are used to power deep space craft and for other uses. "^{239} Pu" is an isotopic form used in the manufacture of nuclear weapons pits. "Weapons grade plutonium" is plutonium in which the abundance of fissionable isotopes of plutonium is high enough that the material is suitable for use in thermonuclear weapons. As used in this document, a "pit" is the central core of a nuclear weapon containing weapons grade plutonium and/or other materials [SSM PEIS, Vol. I, Figure 1.3.2-1.; Glossary].

"Material-at-risk" (MAR) is the amount of material, such as radionuclides, available to be acted on by a given physical stress. For facilities, processes, and activities, the MAR is a value representing some maximum quantity of material present or reasonably anticipated for the process or structure being analyzed.

"Source term" refers to that fraction of radioactive materials present in a building that would be released in the event of an accident.

"Gloveboxes" are specialized pieces of equipment used for working with hazardous or radioactive material such as plutonium, and are comprised of an airtight box with a closed filtration system. A glovebox has thick air-tight gloves to allow a worker to manipulate material without directly touching it [SSM PEIS, Vol. I, Glossary, p. 9-9].

"Seismic hazard" is a description of the potential for dangerous earthquake related natural phenomena such as ground motion (also known as ground shaking) or fault rupture. Ground motion is represented by horizontal as well as vertical accelerations. These accelerations are forces that shake buildings or other structures. Depending on the motions induced in the buildings, structural damage or failure may occur. A fault rupture is permanent ground displacement. If the displacement is sufficient, structural damage to a building may occur.

"Slip rate" is an indicator of the frequency of movement on individual earthquake faults or amount of movement per year. The higher the slip rate, the more movement there is that needs to be accommodated by the fault over a period of time. If the rate of movement is higher, the more likely that earthquakes with damaging ground motion could occur.

"Frequency" is the probability, or chance, that in any given year a particular event could occur. A frequency of "10^{-6} per year" states the chance in any particular year that a given event could occur. In this case, this can also be expressed as the probability that one such event could occur every 1 million years.

"Return period" is commonly used to express the mean time period between events such as between ground motions of a particular amplitude, or between earthquakes of a particular magnitude. "Recurrence interval" is another common term used to express the mean time period between earthquakes of a given magnitude.

"Sabotage," as used in this document, means deliberate acts intended to damage or disable safety and security systems.

Issues Raised Through Judicial Review

This Supplement Analysis examines in detail the following five issues, as required by the August 18 Order.

1. **Implications of recent seismic studies regarding conducting pit manufacturing actions at PF-4, TA-55 and CMR, TA-3.** LANL has completed and DOE has reviewed seven separate studies on seismic conditions in the vicinity of TA-55 and TA-3. These studies are summarized in Appendix A of this Supplement Analysis and incorporated by reference. As described in Appendix A, one of the six studies listed in the August 18 Order was divided into two separate studies, yielding a total of seven completed studies. Five of the studies were completed prior

to issuance of the LANL SWEIS; a summary of these studies is included as Appendix I of the LANL SWEIS. At issue is whether these seven studies present significant new information bearing on the suitability of TA-55 to receive and CMR to support pit manufacturing mission assignments, hence whether the SSM PEIS should be supplemented.

2. **Plausibility of a building-wide fire at PF-4, TA-55, propagated from a glove-box.** LANL has completed and DOE has reviewed a technical analysis setting forth the projected extent to which a building-wide fire initiating in a glove-box in PF-4 at TA-55 could result in the release of ^{238}Pu and ^{239}Pu. The technical analysis is included in Appendix B of this Supplement Analysis. Based on this technical analysis DOE reexamined its previous determinations regarding the plausibility of this type of fire disrupting operations at TA-55.

3. **Plausibility of a building-wide fire at PF-4, TA-55, resulting from a severe earthquake.** LANL has completed and DOE has reviewed a technical analysis setting forth the projected extent to which a fire in PF-4 at TA-55, resulting from a severe earthquake, could lead to a building-wide fire and result in the release of ^{238}Pu and ^{239}Pu. The technical analysis is included in Appendix B of this Supplement Analysis. Based on this technical analysis DOE reexamined its previous determinations regarding the plausibility of this type of fire disrupting operations at TA-55.

4. **Plausibility of a building-wide fire at PF-4, TA-55, resulting from sabotage.** LANL has completed and DOE has reviewed a technical analysis, derived from the Design Basis Threat Policy, on the plausibility of a building-wide fire in PF-4 at TA-55 resulting from sabotage.

5. **Extent to which a building-wide fire at PF-4, TA-55, would result in the release of plutonium.** LANL has completed and DOE has reviewed a technical analysis on the projected extent to which a building-wide fire in PF-4 at TA-55 would result in the release of ^{238}Pu and ^{239}Pu. The technical analysis is included as Appendix C of this Supplement Analysis.

Other Issues

This Supplemental Analysis also examines a sixth issue, not required by the August 18 Order:

6. **Extent to which a building wide fire would result in consequences to the general public surrounding TA-55 and implications for siting the pit manufacturing mission**. DOE has reviewed site-specific information from the LANL SWEIS to estimate the consequences of a release of ^{239}Pu or ^{238}Pu , calculated under issue 5, and has analyzed whether this information should affect its decision to re-establish the pit manufacturing mission at LANL.

PRIOR ANALYSES OF PIT MANUFACTURING MISSION

Overview

Establishing a pit manufacturing capability at LANL has been analyzed in three recent NEPA reviews. The mission to manufacture pits at LANL was established through the 1996 SSM PEIS, as discussed above. In March 1998, DOE prepared a Supplement Analysis which addressed, in part, the SSM PEIS analysis of the pit manufacturing mission. In January 1999, DOE issued the final LANL SWEIS which addressed, among other things, implementing the pit manufacturing mission at LANL.

Pit Manufacturing in SSM PEIS

The 1996 SSM PEIS analyzed the programmatic question of where the DOE could reestablish the capability to produce pits for the nation's nuclear weapons stockpile. That mission assignment had been carried out at DOE's RFP since the early 1950's; as described above, in 1992, DOE lost the RFP capability to manufacture pits. Along with the No Action Alternative of continuing to utilize existing capabilities at both LANL and LLNL, the SSM PEIS analyzed two siting alternatives: LANL and SRS. LANL had maintained the ability to produce limited numbers of prototype pits for design, research and development, or surveillance purposes. Because of that on-going capability, because LANL already had the facility infrastructure needed to work with plutonium, and because of less technical risk overall, LANL was identified in the SSM PEIS as the preferred site for the pit mission and was eventually selected for that mission through the 1996 SSM ROD. The SSM PEIS analyzed a base capacity of up to 50 pits per year, with a surge capacity of up to 80 pits per year if multiple work shifts were used. The SSM ROD assigned the pit manufacturing mission to LANL based on that production rate and stated that if a larger capacity were ever needed, DOE would readdress the question through follow-on NEPA reviews (see ROD excerpt, above).

At issue here is whether the studies provide significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts. Seismic hazards were considered in the SSM PEIS, which noted that "During implementation and operation of the new functions, seismic activity in the area could pose a potential hazard to the facilities and personnel at LANL. Modifications of site facilities to accommodate new pit fabrication functions would take into account the moderate seismic risk in the LANL area. All facilities would be designed for earthquake-generated ground accelerations in accordance with DOE O 420.1 and accompanying safety guides." [SSM PEIS, Volume I, Chapter 4, Section 4.6.3.5, p. 4-289]. Thus, the overall seismic hazard was considered in the context that it can be controlled within the design of the existing buildings and the implementation of the mission in accordance with DOE policy and safety guides. The manner in which any site implements the pit production mission may be different, particularly because of the details of its seismic hazards, but the overall risk of implementing the mission would remain consistent with the DOE's safety guide for protection of the public regardless of the site selected. In such a context, seismic risk posed by the alternatives was not a distinguishing feature for making the siting decision. The specifics of the seismic hazards that were considered for the SSM PEIS will be dealt with in the following discussion.

The SSM PEIS also considered representative accidents to develop the impact estimates for siting the pit program at LANL. Overall the accidents associated with the pit manufacturing program would be expected to have a statistical risk of one fatal cancer to a member of the public approximately every 160,000 years [SSM PEIS, Summary, p. S-38]. These representative accidents included release of radioactive material due to a seismic event at PF-4, TA-55. These accidents did not consider every possible accident, but did consider a spectrum of accidents that represent operations that could be associated with the pit production program. These accidents did not include a building-wide fire because such an event would either be represented or bounded by a different accident scenario. For example, the release of material during a seismic event could bound the possible risk of the release of material during a building-wide fire.
The representative accidents analyzed are associated with pit manufacturing operations. These accidents were analyzed for PF-4 at TA-55, because pit manufacturing activities would be located there. Impacts for accidents associated with other support operations were not analyzed separately, because impacts from these functions occur regardless of whether or not the pit manufacturing program was implemented at LANL. Impacts associated with reconfiguring any site infrastructure would be considered as part of tiered site-specific NEPA analyses.

Pit Manufacturing in SSM PEIS Supplement Analysis

In 1998, as part of the litigation described above, DOE prepared a SSM Supplement Analysis which addressed the SSM analysis and decision leading to establishing the pit manufacturing mission at LANL. The Supplement Analysis considered five issues raised by plaintiffs NRDC et al., and four issues raised by DOE.

- **Issues raised by plaintiffs:**
  Impacts at TA-55, PF-4.
  Connected actions: six projects at TA-55 and TA-3.
  Surge planning scenario: fabricating up to 500 pits per year.
  Safety considerations raised in a December 1997 letter from the Defense Nuclear Facilities Safety Board to DOE.
  Accidents involving ^{238}Pu at PF-4, TA-55.

- **Issues raised by DOE:**

Pit production strategy: formulating a new strategy for implementing pit production at LANL.
CMR construction project management considerations.
CMR safety reviews and organizational changes in 1997 and 1998.
Earthquake faulting studies at LANL: new studies started in 1997.

DOE considered each of these issues in some detail, and for each one, concluded that the information did not warrant preparing a Supplemental SSM PEIS or amending the SSM ROD. The Supplement Analysis was part of the record before the Court in 1998, when the Court granted DOE's motion for summary judgment.

Pit Manufacturing in LANL SWEIS

In January 1999, DOE issued the final LANL SWEIS. This document analyzed the site-specific impacts of implementing the pit manufacturing mission at LANL under the conditions set by the SSM ROD: capacity of up to 50 pits per year under normal mission requirements, with a capacity to surge to 80 pits per year if required. The LANL SWEIS analyzed four alternatives [SWEIS, Vol. I, Chapter 3]:

- No Action (maintain the *status quo*, defined as including the capability and capacity to manufacture up to 14 pits per year);
- Expanded Operations Alternative (identified as the preferred alternative);
- Reduced Operations Alternative;
- "Greener" Alternative, which looked at an emphasis other than the historic weapons-related mission.

Volume II of the Final LANL SWEIS includes project-level analyses for implementing pit production at a level up to 80 pits per year (multiple shifts).

In the final SWEIS, DOE modified the preferred alternative to reflect implementation of the pit production mission in the near term (next ten years) at a capacity of up to only 20 pits per year and a delay implementing the full mission assignment given in the SSM ROD. DOE reiterated that the long-term mission goal remains at 50 to 80 pits per year, and that DOE will continue to examine the means to achieve this goal [SWEIS, Summary, Sec. S.1.3.1; *see also* Vol. II Part B].

The accident analysis in the LANL SWEIS examined representative accidents that either characterize or dominate the risk to the public from site operations. Characterizing accidents includes looking at the type of the accident, the initiator, the materials at risk (MAR), the type of consequences, and the likelihood of the accidents. When evaluating the different alternatives, the accident analysis looked at the ways these representative accidents could change with the alternative or if other representative accident scenarios needed to be included because of the alternative under consideration. The LANL SWEIS concluded that there were negligible differences between the representative accidents for the No Action Alternative and the Expanded Alternative. Thus, the addition of pit manufacturing does not change the types, kinds, consequences, or frequencies of the accidents compared to impacts from ongoing activities that already exist at the site.

ANALYSIS OF ISSUES

Analysis Factors

For each of the six issues outlined above, this Supplement Analysis examines the factors given in the CEQ regulations at 40 CFR 1502.9(c)(l):

> (c) Agencies:
> (1) Shall prepare supplements to either draft or final environmental impact statements if:
> (i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or
> (ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

Analysis of Issues Raised

1. **Implications of recent seismic studies regarding conducting pit manufacturing actions at PF-4, TA-55, and CMR, TA-3.**

Seven seismic studies have been completed over the past year regarding seismic hazards at certain locations at LANL. These studies provide data for determining site specific slip rates and uncertainty estimates. In the Woodward-Clyde Federal Services Report (Wong (1995)), which supported the SSM PEIS, these slip rates had been estimated based on then-available expert judgment and knowledge about the fault systems and seismic activity in the area. Slip rates are fundamental parameters that are used to determine seismic hazard curves. These seismic hazard curves give the ground accelerations, i.e. the ground motion that can be expected at a specific location, along with the probabilities that those accelerations would occur. These seismic hazard curves are then used as input to predict the response of a building or other structure to this ground motion. The amount of ground motion that would lead to structural damage or other types of building failure can be estimated from this information. The information in the seven recent studies does not indicate any need to revise the seismic hazard curves in the Wong (1995) study.

These recent studies also looked into a separate but related item -- surface rupture, which is another mechanism that can lead to structural damage or failure. Surface rupture generally *occurs on existing faults and is defined as permanent ground displacement. Building cracking and failure can occur if ground displacements are large enough. The studies examined several sites, including TA-55 and TA-3, to determine if faults existed there. At TA-55, there is no evidence of a fault, and therefore surface rupture is not an issue for PF-4. At TA-3, a fault exists under the CMR building. However, a surface rupture at CMR sufficient to cause structural damage (cracking) is at least 20 times less likely than ground motion that could also damage the building. Damaging ground motion, as assessed in the Wong (1995) study, therefore remains the most likely result of a seismic event. Thus, the new studies do not indicate a significant increase in the seismic hazard to buildings at LANL compared to the hazards that were considered in preparing the SSM PEIS.*

LANL recently completed seven studies related to the seismic hazard in the vicinity of TA-3 and TA-55. These studies are listed and summarized in Appendix A, and are incorporated by reference into this Supplement Analysis. The LANL SWEIS also includes a summary of those studies completed prior to its issuance in January 1999 and their relevance to the SWEIS analysis of LANL operations [SWEIS, Vol. I, Chapter 4, Sec. 4.2.2.2, and Vol. III, Part B, Appendix I].

These studies are of issue for this Supplement Analysis because they address the seismic hazard at PF-4, TA-55, and CMR, TA-3. In the SSM PEIS, PF-4 at TA-55 was the proposed site for carrying out the pit manufacturing mission. As the tiering document to the PEIS for this mission, the LANL SWEIS examined options for the site-specific implementation of pit manufacturing at LANL. One option analyzed in the SWEIS looked at using CMR to receive certain on-going activities now occurring in PF-4 in order to make additional space available in the facility for pit manufacturing activities (DOE did not propose to manufacture pits at CMR) [SWEIS, Vol. II, Part II]. However, under the LANL SWEIS Preferred Alternative, DOE would not need to move any existing operations from PF-4 to provide a 20 pit per year manufacturing capacity. Under both the No Action and the Preferred Alternatives, DOE would operate CMR over the next ten years to provide analytical chemistry support for all LANL mission assignments, including pit manufacturing. If the Preferred Alternative is selected, DOE would continue to study its long-term options of providing this type of mission support and implementing a 50 pit per year manufacturing capability (80 pit per year multiple-shift capacity). [SWEIS, Summary, p. S-12].

<u>Seismic Hazards at LANL</u>

The term “seismic hazard” refers to and describes the potential for earthquake-related natural phenomena such as ground motion, surface fault rupture, or ground failure. An earthquake originates as movement along a fault, and, as a result of that movement, seismic waves travel away from the fault. One expression of these traveling seismic waves is ground motion, which can shake buildings and result in damage, particularly if the shaking is strong. Ground motion is generally expressed as a fraction of the acceleration due to gravity, with values larger than 0.1 g (g being the acceleration due to gravity [9.8 meters/second^2] and 0.1 g being one tenth of the acceleration due to gravity) being the point that damage to a building starts. Building construction determines when a building will be affected by ground shaking, but most masonry block construction will experience damage at 0.1 g or greater. Buildings with robust seismic designs can withstand much higher ground shaking.

Seismic hazard studies at LANL have been underway since the early 1990's, and these studies continue today. LANL is located on the Pajarito Plateau within the Rio Grande Rift, a seismically active area in the Western United States. The Rio Grande Rift is considered a potential source of earthquakes. Contained within the Rio Grande Rift are a number of individual earthquake faults which are also potential sources of earthquakes.

The presence of these earthquake faults running under Los Alamos County is well known and well documented. Of interest are three faults in the vicinity of LANL: the Pajarito, Guaje Mountain, and Rendija Canyon Faults. The SSM PEIS acknowledged the presence of these faults, and discussed the known moderate seismic risk at LANL [SSM PEIS, Vol. I, Sec. 4.6.2.5, p. 4-256; Vol. I, Sec 4.6.3.5, p. 4-288; Vol. II, Appendix F, Sec. F.2.3.1, p. F-21, F-22; see also SSM PEIS Vol. I, Glossary, definition of "capable fault," p. 9-3]. Although the new studies take a much more detailed look at certain aspects of the seismic hazard than information available to the DOE at the time the SSM PEIS was prepared, the results of these studies do not indicate a significant increase in the seismic hazard.

At the time the SSM PEIS was prepared, the understanding of the seismic hazard at the LANL site was based on the "Seismic Hazards Evaluation of the Los Alamos National Laboratory" prepared by Woodward-Clyde Federal Services (Wong, (1995))[3] (A.R. No. I-1124/1125 Chapter 1, Reference 21; Declaration of Jeffrey K. Kimball, May 18, 1998, Exhibit 2). The Wong (1995) study included paleoseismic investigations, subsurface geologic investigations and evaluation of the seismicity recorded by LANL, as well as reviews of the historical record and previous seismic hazard investigations. This study continues to be the guiding document for establishing ground motion criteria for the design and evaluation of structures, systems and components at LANL [Wong (1995)].

The objective of Wong (1995) was to perform a state-of-the-art probabilistic seismic hazard assessment. The study recognized that very little data on the faults in the vicinity of LANL was available. Steep topography on the Pajarito fault made field measurements difficult and the Rendija Canyon and Guaje Mountain faults had not been fully characterized. To address uncertainties created by the lack of more complete data on the above faults, the study built conservative assumptions (described below) into the seismic hazard assessment.

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[3] In the document filed in *NRDC v Peña*, the Woodward-Clyde Federal Services study was referred to as Wong (1995).

The frequency of movement on individual earthquake faults can be expressed by a rate of slip, or amount of movement per year. The rate of slip on the Pajarito fault, the largest of the three local faults and thus the fault of most significance to LANL, received particular focus in Wong (1995). Wong (1995) also estimated how often earthquakes of various sizes (expressed as earthquake magnitude) occur on each of the faults in the vicinity of LANL.

Accounting for potential high rates of slip (which result in damaging earthquakes more often) for the Pajarito fault was intentionally considered in Wong (1995) to address uncertainties as a result of geologic field studies undertaken as of that date. While the average rate of slip for the Pajarito fault was estimated to be about 0.1millimeters/year (mm/yr), values as large as 0.95 mm/yr were considered and included in Wong (1995) as conservative assumptions. This was done even though there was no direct evidence that the Pajarito fault had experienced movement in historic times (SSM PEIS, Vol. I, Section 4.6.2.5).

At the time that the PEIS was published there was no evidence that any of the three local faults directly intersected a building site. An earthquake fault that directly intersects a building site and experiences a significant earthquake (above magnitude 6 to 6.5) may damage that building as a result of fault movement or displacement commonly referred to as surface rupture.

In 1997, LANL initiated new studies which focus on the seismic history of the Pajarito fault and the potential for surface rupture at TA-55. In 1998, these studies continued and the surface rupture investigation expanded to include TA-3. For surface rupture, studies have centered on mapping faults in specific technical areas. In addition, a probabilistic surface rupture assessment has been completed for TA-3, once it was judged that TA-3 may be intersected by at least one of the faults in the vicinity of LANL (Rendija Canyon).

As discussed in the following sections, the information from these studies indicate that ground motion is still considered to be the predominant seismic hazard. An event that causes surface rupture is much more unlikely than an event that causes damaging ground motion. There is no evidence of seismic ruptures at the TA-55 location. For TA-3, CMR, damaging ground motion remains the most likely result of a seismic event.

The following discussions summarize the results of the studies and their relevance to the understanding of ground motion and surface rupture at LANL.

Seismic Hazard, Ground Motion Results:

As discussed above, the Wong (1995) study was used to support the SSM PEIS. The results of Wong (1995) for the whole of LANL show that, at a return period of 1,000 years, the ground acceleration is 0.22 g amplitude, while at a return period of 10,000 years the ground acceleration is 0.56 g amplitude. These numbers are essentially a summary of the probabilistic hazard curves that have been developed for LANL. Each facility location has a unique hazard curve based on its distance from the main faults in the area. In general, if a building has a seismic capacity that is approximately equal to 0.22g then its frequency of structural damage (cracking) is $1x10^{-3}$. If a building has a seismic capacity that is on the order of 0.56g then its frequency for structural damage (cracking) is $1x10^{-4}$ (Appendix A, Tables 3 & 4). It is these hazard curves that have been used to establish seismic design and evaluation criteria (level of ground shaking) for LANL facilities [Wong (1995), Executive Summary, p. 5]. As discussed below, these curves continue to be valid given the results of the new studies.

As part of the recent seismic studies at LANL, fourteen trenches have been excavated to study the earthquake history on the Pajarito fault. The purpose of the studies has been to determine when the most recent ground rupturing event occurred on the Pajarito fault, to get a better understanding of recurrence intervals for earthquakes (slip rates), and to help determine if the three main faults (Pajarito, Rendija Canyon and Guaje Mountain) in the Los Alamos area are connected.

The results of these studies (Appendix A, Ref. 3 and 14) show that the Pajarito Fault has moved in historic times. The 1997 work found that the most recent event occurred about 1,500 years ago and the 1998 work found that the most recent event occurred between 2,000 and 12,000 to 20,000 yrs ago. Using this new information, slip rates contained in Wong (1995) have been reviewed. The slip rates based on the 1997 and 1998 trench work have been found to fall within the bounds contained in Wong (1995). In other words, the conservative assumptions made by Wong (1995) properly addressed the uncertainty of historic frequency of earthquakes on the Pajarito fault (see Appendix A). The seismic hazard ground motion results contained in Wong (1995), before the DOE at the time the SSM PEIS was prepared, have not changed as a result of the new geologic studies. The assumptions made and the logic used in the Wong (1995) study are still valid [Wong (1995), Table 7.1].

In order to put the results of the next section dealing with surface rupture into perspective, it is important to understand how the seismic hazard curves from Wong (1995) translate into recurrence intervals for damaging ground motion at specific LANL facilities. In recent studies, DOE used seismic hazard curves from Wong (1995) to assess the seismic structural integrity of both PF-4 at TA-55 and CMR at TA-3. Seismic loads that would collapse the PF-4 building structure at TA-55 were originally estimated for the TA-55 Final Safety Analysis Report, and have been updated for this Supplement Analysis. The median capacity for PF-4 at TA-55 is > 1.0g, and is associated with an annual probability of failure of $5x10^{-6}$ per year (200,000 year recurrence interval). Because PF-4 at TA-55 is a modern building built to withstand seismic events, it can resist earthquake ground motion well beyond its design basis (0.3g) prior to reaching structural collapse. Seismic loads which would collapse the CMR building structure were estimated by Goen (1996). The median capacity for CMR (i.e., the ground acceleration which results in a 50% probability of collapse) is 0.14g, and is associated with an annual failure probability of about $2x10^{-3}$ per year (500 year recurrence interval).

Seismic Hazard Surface Rupture Results:

At the time the SSM PEIS was prepared there was no known surface rupture seismic hazard for TA-55 or TA-3. The recent studies resulted in a better understanding of the seismic surface rupture through the preparation of fault maps for various areas of LANL, including those at TA-55 and TA-3.

Fault mapping in a very detailed manner is possible at LANL in part because of the unique topography: the surficial geologic strata are cut by sheer-sided, deep canyons at frequent intervals, which allows for direct observation of the underlying strata. Approximately 15 canyons dissect the land comprising LANL. These run in essentially parallel lines in a west-northwest to east-southeast direction towards the Rio Grande at the eastern boundary of LANL. Detailed mapping of faults has been completed from a high precision three dimensional survey of the cliff faces, core drilling at specific building or potential building sites, and from review of old aerial photographs which pre-dated current buildings, allowing potential geologic features (such as faults) to be identified.

The fault mapping studies indicate that there is no evidence of existing faults in or near TA-55 (Appendix A, Ref. 1), thus the area is not susceptible to surface rupture from earthquakes. For TA-3, it is evident that faults in the Bandelier tuff (which is about 1.22 million years old) with vertical displacements in the range of 1 to 10 feet are present in some areas (Appendix A, Ref. 13), including one under the CMR Building with a vertical offset of approximately 8 feet (Appendix A, Ref. 4). From the probabilistic assessment of surface rupture in the TA-3 area (Appendix A, Ref. 6), earthquakes that might result in permanent ground displacements which would cause significant cracking in buildings are estimated to have a frequency on the order of 10^{-4} (about once in 10,000 years) (Appendix A, Ref. 3). Earthquakes which would result in permanent ground displacements capable of causing structures to collapse are estimated to have a frequency on the order of $1x10^{-5}$ (about once in 100,000 years) (Appendix A). (The current design basis for DOE non-reactor nuclear facilities is to withstand, without collapse, an earthquake that would be expected to occur about once every 10,000 years.)

The relatively long return period for damaging surface rupture at the CMR site is instrumental in evaluating the significance of the new studies. As mentioned above, at the CMR site, the probability of damaging surface rupture is about $1x10^{-4}$ (10,000 year recurrence interval). In contrast, the probability of damaging ground motion to the CMR Building in its current condition is about $2x10^{-3}$ (500 year recurrence interval). This frequency was based on the probabilistic seismic hazard analysis presented in Wong (1995). Thus, the frequency of damaging ground motion is at least 20 times greater than the probability of damage caused by surface rupture, and dominates the risk of seismic damage. Therefore, the presence of the fault under the building, and the accompanying risk of surface rupture and damaging ground displacement, does not significantly increase the seismic risk at CMR, as that risk was understood during the preparation of the SSM PEIS.

DOE Plans for Pit Manufacturing

Although the new studies provide valuable information regarding the seismic hazard at LANL, this information would not significantly change the outcome of the impact analysis in the SSM PEIS. The current estimations of the collapse of PF-4 at TA-55 gives a frequency of $5x10^{-6}$ which is well beyond its design basis of providing confinement functions at the Design Basis Earthquake. Thus, at TA-55, damaging ground motion does not play a major factor for the structural integrity of the building until frequencies are at or beyond $5x10^{-6}$ (Appendix B, Section 4.4, Table 4.2 & 4.3, Sequence 11). Accidents with the release of radioactive material for TA-55 were considered at a wide range of accident frequencies in the SSM PEIS (10^{-4} to 10^{-7}). Differences of an order of magnitude are within the uncertainty band for these types of events. After reviewing the new seismic studies, DOE still considers that the accidental release of radioactive material due to a seismic event is very unlikely at LANL. DOE believes that PF-4, TA-55 is not at greater seismic risk than originally considered for the SSM PEIS.

The new surface rupture seismic hazard information is most pertinent in relation to the CMR Building. Even here, however, consideration of the new information has not significantly increased DOE's assessment of the resulting seismic risk of structural damage. DOE will continue to operate the CMR Building at LANL to provide analytical chemistry support to the ongoing research and science activities it now supports, including pit manufacturing. In this context, it should be understood that the impacts for operating CMR were considered in the SSM PEIS as part of the No Action Alternative, because CMR was not part of the proposal for the pit manufacturing mission (no pit manufacturing operations would be conducted in CMR). Instead, CMR is part of the LANL infrastructure that is maintained to support all of its missions. The SSM PEIS acknowledged that this infrastructure would be maintained and therefore DOE would not have to establish a new infrastructure at LANL to provide this support.

Support for analytical chemistry will continue at LANL, even though specific decisions on CMR operations may change and DOE may consider alternative means to provide analytical chemistry support in future reviews. DOE may decide, as indicated in the recent SWEIS, that it is not cost-effective to complete the planned seismic upgrades to CMR at this time [SWEIS, Summary, Sec. S.1.3.1, p. S-13; Vol. III, Part B, Appendix I]. If DOE selects the preferred alternative for pit manufacturing in the SWEIS, it will not be necessary to move specific operations from PF-4, TA-55, to CMR to make more dedicated space in PF-4 available for pit manufacturing operations [SWEIS, Summary, Sec. S.1.3.1, p. S-13;Vol. I, Sec. 4.2.2.2, p. 4-29; Vl. II, Part II]. In that case, further evaluation will be considered for implementing pit manufacturing above a capacity of

20 pits per year. However, in any event, support for analytical chemistry operations at LANL will be retained at CMR.

2. Plausibility of a building-wide fire at PF-4, TA-55, propagated from a glove-box.

Appendix B provides details of the probability assessment for a building-wide fire at PF-4, TA-55, propagated from a glove-box fire. The event has been evaluated as the probability that a fire could propagate from a glove-box and spread to engulf the entire facility. The combination of design features, limits on combustible loading, and mitigative features at PF-4, TA-55, make the probability of such an event on the order of $1x10^{-10}$ per year or lower (i.e., once in every 10 billion years). Because the probability of such an event is so remote, the accident is not considered plausible.

PF-4, at TA-55, is the building where DOE has manufactured prototype pits in the past and will manufacture pits pursuant to the SSM ROD. The potential for fire at PF-4 is of interest to DOE because of the need both to protect worker life, health and safety, and to guard against release of radioactive material to the environment. Through the SSM PEIS, DOE considered the incremental impacts of locating the pit manufacturing mission at LANL. The impacts were estimated based on examination of representative accidents for pit manufacturing. These accidents were considered to bound the additional risk of implementing a pit manufacturing mission at LANL. The specific risk of a building-wide fire resulting from a glove-box fire was not shown in detail because it falls within the range of risks presented in the SSM PEIS. The risks established for the pit fabrication mission was one (1) excess latent cancer fatality (LCF) in 160,000 years or $6.2x10^{-6}$ LCF per year [SSM PEIS, Summary, p. S-38].

The SSM PEIS analyzed the incremental environmental impacts and the incremental increase in source term that would occur if the pit manufacturing mission were to be reestablished at LANL. Pit manufacturing operations and the handling of pit materials were proposed to take place in PF-4 alongside other ongoing activities and missions involving special nuclear materials. The SSM PEIS analyzed impacts from accidents as well as impacts from normal operations. One accident scenario analyzed in the SSM PEIS was a fire starting outside of a glove-box that would damage the gloves and result in a release of plutonium [SSM PEIS, Vol. II, Appendix F, Sec. F.2.3.1, p. F-20]. The SSM PEIS concluded that the frequency and the amount of material that would be released would be the same regardless if the pit fabrication mission were reestablished at LANL or SRS [SSM PEIS, Vol. II, Appendix F, Sec. F.2.3.1, p. F-20].

The issue to be examined in this SA is the plausibility of a building-wide fire in PF-4[4]. This result is slightly different than what was considered for the SSM PEIS, since the objective there was to look at only the changed risks that could be incurred due to the implementation of a pit

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[4] The consequences of a building-wide fire are examined below in a separate section.

manufacturing mission at LANL. In this analysis the objective is to look at the plausibility of building-wide fire regardless of whether the mechanisms can be associated with pit manufacturing type operations or separate on-going operations. However, since the same operations needed for pit manufacturing currently exist in PF-4, the frequency of a building-wide fire would not increase with the addition of this mission to PF-4.

One way the public could be exposed to the radioactive materials in PF-4 would be if there were a breach in the building structure or the containment for the radioactive materials; one cause of breaching could be a fire. One way that a fire could occur in PF-4 would be from spontaneous combustion of pyrophoric materials (such as plutonium) inside the glove-boxes used to handle the material.

RFP experienced fires in its plutonium handling lines in the 1950's and again in the 1960's; a major fire occurred in 1969. The 1969 RFP fire is discussed in the SWEIS [SWEIS, Vol. I, Sec. 5.2.11.2, p. 5-89; Appendix G, Sec. G.4.1.2, p. G-50]. DOE learned from the RFP experience and incorporated the lessons learned into subsequent design and operating standards for its nuclear facilities. PF-4, at TA-55, was constructed in the 1970's and the design of the facility and equipment such as the glove-boxes took into account the lessons learned from the cause and spread of the RFP fires.

Because plutonium metal is pyrophoric, and subject to spontaneous combustion in certain forms or circumstances, there is a risk of a plutonium fire starting within the glove-boxes used to handle the material. To counter that risk the glove-boxes contain an inert atmosphere, such as argon or nitrogen, which will mitigate the potential for ignition of the plutonium. Other means to counter the hazard of fire include controls on equipment and materials. The glove-boxes are made from metal, glass and plastics that do not easily burn, the plutonium material is kept in containers except when in use, and the amount of combustible material in the glove-box is carefully controlled. PF-4 is robustly designed with many engineered safety features including passive controls (such as firewalls), systems controls (such as alarms) and administrative controls (such as limits on the amount of nuclear material which may be held in any given location and transient combustibles allowed in a given room).

The report, *Probabilistic Analysis of the Potential for Building-Wide Fire in PF-4*, Appendix B, provides a technical analysis of the potential for a building-wide fire at PF-4. The analysis considers the probability of a fire that starts as a small fire inside a glove-box and spreads to a building-wide fire, eventually engulfing all of PF-4. Based on consideration of both the probabilistic analysis presented in Appendix B and of the engineering design and administrative controls in place, the scenario of a building-wide fire at PF-4 starting from a glove-box fire is not a plausible event.

Appendix B used a standard probabilistic accident risk analysis “event tree” model to portray various ways that a fire could progress through PF-4. The “event tree” allows a time-sequence from the initiating event (that is, a fire in a glove box) through intermediate steps (such as “spread to the room,” “spread to a larger area”) to the final event (such as “building-wide fire”). These pathways are called the “accident sequence.” For each “accident sequence,” a probability of occurrence was determined by multiplying the frequency of the initiating event (such as “average number of glove-box fires expected per year”) with the probability for failure or success of each of the intermediate steps (such as the likelihood that a firewall would be breached or otherwise fail). The conclusion of the analysis was that the probability of a building-wide fire starting from a fire inside a glove-box is extremely unlikely, about one chance in approximately 10 billion years ($1x10^{-10}$).

The extremely low probability is due to the fact that a number of barriers have to fail in order for a fire to spread. These include: first, there has to be a failure of administrative limits on the amount of combustible material held in one place to result in enough combustible material to sustain a fire; second, the fire rated walls would have to fail; third, the fire detection system would have to fail; fourth, the fire suppression system would have to fail; fifth, the ventilation system would have to fail; sixth, the corridor spacing is such that it would be extremely difficult for a fire to bridge this gap; and seventh, the barrier wall which separates the two halves of the building would have to fail. Under this scenario there would be no common occurrence or initiating event that would cause failure of all of these systems; therefore the probability of a building-wide fire spreading from a fire inside of a glove-box, regardless of the location of the glove-box within PF-4, becomes vanishingly small.

This analysis concludes (1) that the SSM PEIS analyzed an accident comparable to a building-wide fire at PF-4 resulting from the propagation of a glove-box fire, (2) the frequency of a building-wide fire caused in this manner would not increase with the addition of the pit manufacturing mission and (3) that the probability of such a fire occurring is extremely small. Therefore, the analysis does not provide significant new circumstances or information relevant to environmental concerns, and consequently no supplement to the SSM PEIS is required.

3. Plausibility of a building-wide fire at PF-4, TA-55, resulting from a severe earthquake.

Appendix B provides details of the probability assessment for a building-wide fire in PF-4, TA-55, resulting from a severe earthquake. The event has been evaluated as the probability that a building-wide fire could propagate from random fires or specific room fires resulting from a severe earthquake. The combination of design features, limits on combustible loading, and mitigative features in PF-4 at TA-55 make the probability of such an event on the order of $4x10^{-6}$ per year (i.e., once in every 250,000 years). Because the probability of such an event is extremely unlikely, the accident is not considered plausible.

The release of material in a building-wide fire due to a severe earthquake was not presented in the SSM PEIS, although the PEIS did discuss the known moderate seismic risk at LANL and did consider the potential for accidental release of radioactive materials due to a seismic event [SSM PEIS, Vol. II, Appendix F, Sec. F.2.3.1, p. F-21, F-22]. As noted above under Issue 1, the likelihood of an earthquake strong enough to cause structural collapse of PF-4 is considered to be very low, and recent seismic studies of this area do not indicate that there would be a significant increase in this low probability from that considered in the SSM PEIS.

One way that a fire could occur in PF-4 would be if there were a severe earthquake that resulted in failure of a glove-box, which could expose flammable materials to an ignition source such as a heat source operating at the time of the event. In addition, if an earthquake did result in structural damage to PF-4, there could be sufficient damage to the building or fire suppression systems that it would be difficult to extinguish a fire. Moreover, an earthquake strong enough to cause structural damage to PF-4 would also probably cause damage to roads and disrupt emergency response services.

Appendix B to this Supplement Analysis analyzes the probability of a fire that starts as a result of a seismic event and spreads to a building-wide fire, eventually engulfing all of PF-4. Based on consideration of both the probabilistic analysis presented in Appendix B and of the engineering design and administrative controls in place, the scenario of a building-wide fire at PF-4 arising after a severe earthquake is not plausible.

A standard probabilistic accident risk analysis “event tree” model was used to portray various ways that a fire could progress through PF-4. This model is described above under Issue 2. For a fire starting after a severe earthquake, the “accident sequences” assumed that one or more fire suppression systems fail, and that internal as well as external walls fail. The conclusion of the analysis was that the probability of a fire starting in the aftermath of a severe earthquake spreading to a building-wide fire at PF-4 would be very low, or about one chance in approximately 250,000 years ($4x10^{-6}$).

The low frequency reflects the fact that several failures would have to occur simultaneously to reach the final state of a building-wide fire. In addition to the failure of the integrity of the glove-box, the following would have to happen: there must be an ignition source close enough to flammable materials to start a fire; the fire sprinkler system must fail; and there would have to be a large-scale violation of administrative controls regarding placement of material. On the other hand, these failures were also modeled in a conservative manner. For example, possible ignition sources were considered to be capable of starting a fire 100% of the time even though they are turned off for a significant periods of time during each day. The fire spread was assumed to be independent of the operational status of the ventilation system. If this were analyzed further, the results could possibly increase the combustible loading necessary to sustain and propagate the fire.

Also the heat loading to the fire walls was assumed to be very high; this assumption made the combustible loading higher than would actually be the case if the fire was assumed to grow until it reached a maximum heat load to the fire walls. Because of the conservative assumptions and methods used in modeling this accident scenario along with its low frequency, this event is not considered plausible.

This scenario does not represent a release of materials due to the operation of pit manufacturing. Instead the possibility that the fire could spread is a function of the on-going work at TA-55 that is not associated with pit production work. As indicated in the LANL SWEIS, the addition of the pit production work would not change the frequency (or the consequences) of this event, since the amounts and distribution of material in PF-4 is also not expected to change.

This analysis concludes that the probability of a building-wide fire at PF-4 as the result of a severe earthquake is very small and well within the assumptions of the SSM PEIS regarding seismic events at LANL. Therefore, the analysis does not provide significant new circumstances or information relevant to environmental concerns, and consequently no supplement to the SSM PEIS is required.

4. Plausibility of a building-wide fire at PF-4, TA-55, resulting from sabotage.

A building-wide fire at PF-4, TA-55, resulting from an act of sabotage is not plausible, based on a number of multi-faceted and validated mechanisms that are in place to preclude such an occurrence. These measures include a Vulnerability Assessment (VA) for each nuclear weapons facility consistent with the Design Basis Threat (DBT) Policy for Department of Energy Programs and Facilities, an approved Human Reliability Program for employees, and physical security and access controls that are documented in a facility Site Safeguards and Security Plan (SSSP). In addition, there are periodic Security Surveys, Self Assessments, and Independent Oversight Evaluations to validate compliance with DOE safeguards and security protection requirements. Based on these in-depth preventative measures, no credible adversaries were determined to possess the capability, motive and opportunity to initiate a building wide fire at PF-4.

DOE did not explicitly consider, in the SSM PEIS, impacts resulting from possible acts of sabotage. In developing its overall NEPA policy and program, DOE has acknowledged that these impacts are often the same as, or similar to, the impacts associated with accident scenarios, and are therefore bounded by the analysis in the SSM PEIS. Accordingly, DOE does not attempt to consider them as a separate part of a NEPA impact analysis. In addition, consideration of sabotage would not, in general, help DOE distinguish among alternatives, because the means to protect material against theft, terrorists, and other threats would be similar regardless of the alternative selected. Therefore, there is no sabotage-related scenario analyzed in the SSM PEIS.

DOE facilities could be the focus of many specific threats; and analyses are performed to determine, for each identified threat, the potential adversaries and their likely objectives. DOE Order 470.1, "Safeguards and Security Program," directs all major nuclear facilities to have a current SSSP which includes a VA Report. As part of this process, a comprehensive analysis is conducted of various sets of credible threats to DOE facilities with various types of adversary (e.g., an employee seeking to cause a sabotage event). The result of this comprehensive analysis is the identification of both potential risks and the security measures necessary to ensure that adversaries cannot achieve their objectives. The SSSP contains, at a minimum, current protection strategies, programs, procedures and risk assessments validated through performance testing which is specific to major threats. A formal validation of the SSSP is conducted by the relevant DOE Operations Office in conjunction with the DOE Headquarters Office of Security Affairs and the Program Office to ensure that the Plan adequately addresses all threats, in-depth facility protection elements, corrective actions to mitigate identified vulnerabilities, and reduction of residual risks.

The first stage of the analysis is adversary identification, using the DBT Policy. The current document implementing the policy is the "Design Basis Threat for Department of Energy Programs and Facilities," February 1999. This classified document was coordinated with the Department of Defense (DoD), the Nuclear Regulatory Commission, the DoD U.S. Nuclear Command and Control System Support Staff, and the Federal Bureau of Investigation (FBI). The document was produced in accordance with existing Memoranda of Agreement on Design Basis Threats, and is based upon information provided by the intelligence community, including the Department of Justice, the FBI, the Central Intelligence Agency, the Defense Intelligence Agency, and the Bureau of Alcohol, Tobacco and Firearms. This document identifies, characterizes and estimates the capabilities of a wide range of adversaries including terrorists, white-collar criminals, organized criminals, psychotics, disgruntled employees, violent activists, and intelligence collectors.

Everyone working in PF-4, TA-55, is covered by an approved Human Reliability Program (HRP). Each HRP includes at a minimum, the following elements: an individual security clearance/access authorization, initial and random substance abuse testing, initial and annual medical assessments which may include a psychological evaluation, and an annual supervisory review. The LANL HRP was established in accordance with the requirements of 10 CFR Part 710, and is designed to identify any individuals whose judgment may be impaired by physical or emotional disorders, or substance abuse, including the excessive use of alcohol. The HRP, in concert with DBT provisions and combined other non-HRP elements of a multi-faceted insider threat mitigation program (e.g. personnel security, a materials control and accountability program, administrative procedures, a "two-person rule", an employee assistance program and/or mental health program), greatly reduces the risk of an employee committing a violent act such as sabotage.

Assessments and inspections at the PF-4, TA-55 facility have confirmed that an approved, validated HRP is in place, and is combined with the other defense in-depth elements described above. Personnel with direct access to special nuclear materials (SNM) and unescorted access into the PF-4 Material Access Area (MAA) are covered by the HRP. Other individuals who may require a single access into the MAA are escorted by at least one qualified PF-4 HRP-covered escort at all times. Escorts receive special training designed to ensure that SNM protection elements that are in place to ensure safety and security are not compromised.

Access into the TA-55 Protected Area is through an entry portal under the control and observation of Security Police Officers (SPO's). These portals are equipped with metal detectors, SNM detectors and an X-ray machine. Regular TA-55 employees require a DOE standard badge with a magnetic strip and a personal identification number (PIN) for entry at both vehicle and personnel portals. Employees swipe their badges through a badge reader and enter their PIN. A database verifies the compatibility of the PIN and checks the information on the badge. It also notifies the SPO who is controlling the portal access. The SPO physically compares the picture on the badge with the individual. Only after personnel successfully undergo the entry portal screening checks are they granted access into the Protected Area. Additional screening is required prior to entry into PF-4. Access to the PF-4 MAA is further limited by requirements for a specific access authorization after certification of proper security and safety training.

To achieve a sabotage-related building-wide fire at TA-55, PF-4, an adversary would have to possess characteristics and capabilities regarding personality, training, knowledge, skill levels, etc., that are incompatible with the characteristics and capabilities determined to be credible by the multi-agency intelligence community. For example, an adversary could be postulated to be an insider, but in order to cause a building-wide fire, that insider would have to possess an extensive knowledge of the defeat mechanisms for TA-55, PF-4 plutonium processing, have the ability to overcome the administrative limits for materials in process, have a knowledge of source term effects, and the ability to defeat fire suppressing systems, alarms, propagation barriers, and security procedures, and, notwithstanding the screening mechanisms of the HRP, be prone to violent acts. On this basis a building-wide fire resulting from an act of sabotage is not considered plausible. This analysis does not provide significant new circumstances or information relevant to environmental concerns, and consequently no supplement to the SSM PEIS is required.

5. Extent to which a building-wide fire in PF-4, TA-55, would result in the release of plutonium.

The source term for a building-wide fire in PF-4, TA-55, was assessed to determine the extent of potential plutonium release in a building-wide fire. Appendix C provides a detailed description of the source term analysis. A total source term of 123 g ^{239}Pu dose equivalent was calculated from all operations, with 56 g being associated with ^{238}Pu sources and 67 g being associated with weapons-grade plutonium sources.

The SSM PEIS did consider the extent of radioactive release of material due to various accident scenarios. The amount of material assumed to be released was the potential incremental increase as a result of adding pit manufacturing operations. Thus, in the SSM PEIS the accident analysis assumed the release of an additional 0.61 to 0.63 g of plutonium in an evaluation basis earthquake and a beyond-evaluation-basis earthquake [SSM PEIS, Appendix F, Sec. F.2.3]. In contrast, the analysis in the following discussion applies to material from all of PF-4, including operations not associated with pit manufacturing.

If an accident were to occur, particles that are respirable, 10 μm Aerodynamic Equivalent Diameter or less, could be transported through the air and inhaled into the human respiratory system. Moreover, because the majority of the nuclear materials in PF-4 are alpha emitters, the respirable particles would provide the greatest dose and are therefore of primary interest in determining the potential effects of an accidental release of material. The extent to which plutonium is released from a building wide-fire would best be quantified by the amount of respirable particles released to the environment. This quantity and form of released material is commonly referred to as the "source term."

A number of factors affect the amount of material that could be released during a fire. These factors include the material form, the nature of the accidents, quantities of material affected by the accident and other factors. For these calculations, a best estimate source term was evaluated for a postulated building-wide fire (App C, p. C-2). This means that the calculations were not based on the maximum allowable inventories in PF-4. Rather, they were based on the "expected" values for the materials at risk (MAR) and take into account the mechanisms by which this material could be exposed to the fire.

A technical report on the considerations that went into the source term analysis is presented in "Building-Wide Fire: TA-55/PF-4 Source Term," Appendix C of this Supplement Analysis. The total source term for this analysis is 123 g of ^{239}Pu dose equivalent. The source term comprises 56 g of ^{239}Pu dose equivalent from ^{238}Pu sources and 67 g of ^{239}Pu dose equivalent from weapons-grade plutonium sources.

This source term would include contributions from all available inventory used in or stored in glove-boxes in PF-4. The inventory supports all on-going operations conducted in the facility. The distribution of material in glove-boxes and the average available quantities are not expected to change substantially with pit production. Thus, this analysis represents an "expected" release amount for operating TA-55, including consideration of the modifications for pit production.

6. Extent to which a building-wide fire would result in consequences to the general public surrounding TA-55 and implications for siting the pit manufacturing mission.

The consequences of a building-wide fire at TA-55 have been estimated at 22 to 33 excess latent cancer fatalities (LCFs). No prompt fatalities would be expected from radiation exposure. If the fire were a result of a severe earthquake, fatalities would be expected in the general population as a result of the earthquake itself. Incremental changes in inventories and actual processes due to a pit manufacturing mission at PF-4, TA-55 would be minor. Therefore, the possible incremental increases in either the source term or the consequences would be negligible.

The consequence to the public surrounding TA-55 in the event of an earthquake are estimated to be approximately 22 to 33 excess LCFs. This estimate is based on consequences and source terms provided in the LANL SWEIS, accident scenario "Site-03, Site-Wide Earthquake Causing Damage to All Structures/Internals" [LANL SWEIS, Appendix G, p. G-73 and p. G-99]. By scaling these results, the consequences for a building-wide fire can be estimated. Specifically, the LANL SWEIS concluded that an earthquake of this magnitude would result in the following releases:

Initial Plume

Material	Amount (grams)
^{238}Pu	2.04
^{239}Pu	69.2
^{240}Pu	0.062
^{242}Pu	3.36
HEU	3.74

In Suspension from Material at the Accident Site

Material	Amount (grams)
^{238}Pu	1.95
^{239}Pu	71.2
^{240}Pu	0.3
^{242}Pu	3.22
HEU	3.6

(LANL SWEIS, p. G-72). These quantities are equivalent to a dose that would be received from 1218 g ^{239}Pu[5]. The release of 1218 g ^{239}Pu dose equivalent would result in 111 excess latent cancer fatalities which would be the contribution from TA-55 to the overall estimates of 134 excess LCFs in the Site-03 earthquake [LANL SWEIS, Appendix G, p. G-76]. Thus, the LCFs per gram (^{239}Pu equivalent) is on the order of 0.09 LCF per gram. Using this value, the 123 g (^{239}Pu dose equivalent, Expected MAR value) released during a postulated building wide fire would result in approximately 11 LCF. The transport of material within a buoyant release, such as for a fire, can be two to three times greater than the transport of a non-buoyant release, such as in the case of a seismic collapse. Therefore, for purposes of this analysis, it is assumed that a

[5] The SWEIS calculation of a release of 1218 g ^{239}Pu equivalent is based on a severe earthquake at TA-55. In order to give an upper bound for the possible impacts, the SWEIS analysis assumed that the maximum amount of material allowed by administrative limits would be at risk at the time of the earthquake. In contrast, as discussed in the previous section and also in Appendix C, this Supplement Analysis reflects a more likely "actual" or "expected" amount of material at risk in calculating a 123 g.^{239}Pu dose equivalent as the extent to which a building wide fire would result in the release of plutonium.

building wide fire at TA-55 could result in an additional dose that would lead to 22 to 33 excess LCF's.

No prompt fatalities would be expected from population exposures of this magnitude. An individual latent cancer fatality risk for this accident would be on the order of 7.3×10^{-9} LCF/ year [(33 excess LCF / 18,000 people) x 4×10^{-6} per year = 7.3×10^{-9} excess LCF per individual per year][6]. This value, when compared to the safety goal of 2×10^{-6} LCF/yr, as outlined in the DOE Nuclear Safety Policy (SEN 35-91), represents a very small fraction of the safety goal, about 0.37%.

It is important to note that these consequences are based on the MAR for PF-4, at TA-55, as a whole. This analysis demonstrates that the probability of those consequences occurring are extremely unlikely and therefore the risks are extremely small. However, the key question for a decision on whether to site the pit manufacturing mission is what are the incremental additional impacts of that mission. DOE has consistently maintained that adding the pit production mission will not significantly change the general distribution of material or the amount of MAR in TA-55. The PEIS assumed that adding the pit manufacturing mission would result in an additional release of 0.61g to 0.63 g of plutonium in the event of an earthquake-induced collapse of TA-55, with projected consequences of 0.014 excess LCFs. In preparing the more detailed analysis for the LANL SWEIS, DOE concluded that any difference between the MAR, with and without the pit manufacturing mission, would be nominal and would be well within the day-to-day variance of the amount of material on the floor of the facility and not in the storage vaults. Thus, the analysis for both the LANL SWEIS No Action Alternative (without the additional pit manufacturing mission) and the Expanded Operations Alternative (with the additional pit manufacturing mission) assumed that the same amount of material would be at risk, as controlled by administrative limits for the facility. Therefore, the analysis contained in the SSM PEIS adequately bounded the impacts of a catastrophic accident at TA-55, such as a building-wide fire, in the context of adding the pit manufacturing mission to the facility.

This analysis concludes (1) that the risk of an individual latent cancer fatality as a result of a building-wide fire at PF-4 is very small and (2) that the SSM PEIS adequately bounded the effect which adding the pit manufacturing mission to PF-4 would have on the impacts of such a fire. Therefore, the analysis does not provide significant new circumstances or information relevant to environmental concerns, and consequently no supplement to the SSM PEIS is required.

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[6] The number of excess LCF was estimated for a population within a 80 kilometer (50 mile) radius of TA-55. For purposes of a conservative comparison with the DOE safety goal, this dose has been assigned to the population within a 10 mile radius, approximately 18,000 people, instead of the population within a 50 mile radius, approximately 290,000 people. This conservative comparison is made to ensure that a comparison to the Safety Goal is not unduly biased by lower doses over a larger population at greater distances from the facility.

CONCLUSIONS

In this Supplement Analysis, DOE has considered the new information available from the seven recent seismic studies and has developed more detailed analysis on the potential for building-wide fires in PF-4 at TA-55. This information and analysis has been compared to the environmental impacts that were known at the time the SSM PEIS was prepared to determine if they are significant and would substantially influence the decision to site the pit manufacturing mission at LANL. DOE has reached the following conclusions.

- At the time the SSM PEIS was prepared, the understanding of seismic hazard at the LANL site was based on the conclusions of Wong (1995). The recent seismic studies reaffirmed those conclusions. That is, the slip rates calculated from the recent studies fall within the range of slip rates assumed in Wong (1995).
- Likewise, the Wong (1995) seismic hazard curves developed from the slip rates remain valid for estimating recurrence intervals for damaging ground motion at specific facilities. The ground acceleration with a 50% probability of collapse has a 200,000 year recurrence interval for PF-4 at TA-55, and a 500 year recurrence interval for CMR. (Appendices A and B).
- The recent seismic studies determined that there are no faults in the area of PF-4, and thus there is no risk of surface rupture in the area of PF-4 at TA-55.
- The recent seismic studies determined that there is a fault under CMR, and concluded that the recurrence interval for damaging surface rupture (building cracking) for the facility is at least 10,000 years. However, since this is 20 times less than the probability of damaging ground motion for the facility, the detection of the fault does not significantly alter the risk of damage to CMR from an earthquake.
- A probabilistic risk assessment, based on very conservative assumptions, concluded that the probability of a glove-box fire in PF-4 propagating into a building-wide fire is once in every 10 billion years.
- The same assessment concluded that the probability of a building-wide fire occurring in PF-4 as a result of a severe earthquake is once in every 250,000 years.
- There are sufficient preventative mechanisms in place to preclude an act of sabotage which would result in a building-wide fire in PF-4.
- A building-wide fire in PF-4 would result in the release of small amounts of various isotopes of plutonium, totaling the equivalent of 123 grams of plutonium 239.
- A release of this magnitude as a result of a building-wide fire could lead to 22 to 33 latent cancer fatalities. An individual latent cancer fatality risk for this accident would be approximately 7.3×10^{-9} LCF/year. This is less than one percent of DOE’s safety goal. No prompt fatalities would be expected from population exposures of this magnitude.

This Supplement Analysis also reaffirms the following conclusions germane to DOE’s decision to site the pit manufacturing mission at PF-4, TA-55:

- Manufacturing pits for the U.S. nuclear weapons stockpile will not significantly increase the amount of nuclear materials at risk at any one time in PF-4.
- DOE does not now propose, and has never proposed, to manufacture pits in CMR.
- If DOE implements the preferred alternative of the LANL SWEIS, no operations will be moved from PF-4 to CMR in order to site the pit manufacturing mission in PF-4.

As a result of the information and analysis contained in this Supplement Analysis, DOE has concluded that none of the six issues analyzed in this Supplement Analysis either represent substantial changes to the actions considered in the SSM PEIS, or provide significant new information relevant to the environmental concerns discussed in the SSM PEIS, and therefore that no supplement to the SSM PEIS is required.